

Radio test report **20145012300-Ver 1.00**

based on:

FCC part 15; subpart C; section 15.247 (ed. 10-1-14);
FCC part 15, subpart B, section 15.109 (ed. 10-1-14);
IC RSS 210, Annex 8 (issue 8); IC RSS-Gen (issue 4)

Remote Control
VELUX
2014-RC003-02

Revision history

REVISION	DATE	REMARKS	REVISED BY
Ver 1.00	25 February 2015	Version for first release	ing. J.C. le Clercq
Ver 0.50	12 February 2015	Version for peer review	ing. J.C. le Clercq

Contents

REVISION HISTORY	2
MAIN MODULE.....	4
1.....INTRODUCTION	4
2.....PRODUCT	5
3.....TEST SCHEDULE	5
4.....PRODUCT DOCUMENTATION.....	6
5.....OBSERVATIONS AND COMMENTS	6
6.....MODIFICATIONS TO THE SAMPLE.....	7
7.....SUMMARY.....	7
8.....CONCLUSIONS	8
TEST RESULTS MODULE.....	9
1.....GENERAL INFORMATION	9
1.1 Equipment information	9
1.2 Tested channels.....	9
2.....EMISSION TESTS	10
2.1 Maximum conducted output power.....	10
2.2 Minimum 6 dB bandwidth	11
2.3 99% emission bandwidth	12
2.4 TX unwanted emissions attenuation (conducted, 0.03 - 26 GHz).....	13
2.5 Power spectral density conducted to the antenna	14
2.6 Average factor	15
2.7 TX unwanted emissions in the restricted bands	16
2.8 RX unwanted emissions (radiated, 0.03 - 1 GHz).....	17
2.9 RX unwanted emissions (radiated, 1 - 13 GHz).....	19
USED TEST EQUIPMENT MODULE.....	21
CROSS REFERENCE TABLE.....	22

Main module

1 Introduction

This report contains the result of tests performed by:

Telefication B.V.
Edisonstraat 12a
6902 PK Zevenaar
The Netherlands

Telefication complies with the accreditation criteria for test laboratories as laid down in ISO/IEC 17025:2005. The accreditation covers the quality system of the laboratory as well as the specific activities as described in the authorized annex bearing the accreditation number L021 and is granted on 30 November 1990 by the Dutch Council For Accreditation (RvA: Raad voor Accreditatie).

Telefication is designated by the FCC as an Accredited Test Firm for compliance testing of equipment subject to Certification under Parts 15 & 18. The Registration Number is: 282250.

The Industry Canada number for the Open Area Test Site of Telefication is: 4173A-1.

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Ordering party:

Company name : Velux A/S
Address : Baekgaardsvej 40
Zipcode : 6900
City/town : Skjern
Country : Denmark
Date of order : 13 November 2014

2 Product

A sample of the following product was submitted for testing:

Product description	:	Remote Control
Manufacturer	:	Velux A/S
Trade mark	:	VELUX
Type designation	:	2014-RC003-02
FCC ID	:	XSG835403
IC ID	:	8642A-835403
Serial number	:	--
Hardware release	:	--
Software release	:	--

3 Test schedule

Tests are carried out in accordance with the specification detailed in chapter 7 “Summary” of this report.

Tests are carried out at the following location:

- Telefication, Zevenaar

The sample of the product is received on:

- 6 January 2015

Tests are carried out between:

- 6 and 10 February 2015

4 Product documentation

For production of this report the following product documentation has been used:

Identification:	Date:
3LR A12 exploded view.pdf	09-02-2015
3LR A12 PCB layout.pdf	09-02-2015
3LR A12 Quick guide 453065-2012-11.pdf	09-02-2015
3LR A12 US BOM.xlsx	09-02-2015
3LR A12 User guide 453347-2014-01.pdf	09-02-2015
3LR A12 WW BOM.xlsx	09-02-2015
3LR_A12_US schematic.pdf	10-02-2015
Communication Duty Cycles.pdf	10-02-2015
KLR200 US range and antenna.pdf	10-02-2015
RF Test Modes.pdf	10-02-2015

The above-mentioned documentation will be filed at Telefication for a period of 10 years following the issue of this test report.

5 Observations and comments

The EUT was able to transmit or receive continuously on one out of three channels.

Furthermore the EUT was able to operate in normal (intermittent) mode.

FCC part15 section 15.215: not tested

The EUT is deemed to meet the requirements because of the frequency space between the band edges and the lowest and highest operating channels.

6 Modifications to the sample

No modifications are made to the sample.

7 Summary

The product is intended for use in the following application area(s):

INTENTIONAL RADIATOR OPERATING IN THE FREQUENCY BAND 2400 - 2483.5 MHz

The sample is tested according to the following specification(s):

- FCC part 15; subpart C; section 15.247 (ed. 10-1-14); FCC part 15, subpart B, section 15.109 (ed. 10-1-14);
- IC RSS 210, Annex 8 (issue 8); IC RSS-Gen (issue 4)

8 Conclusions

The samples of the product showed **NO NON-COMPLIANCES** to the specification stated in chapter 7 of this report:

The results of the tests as stated in this report, are exclusively applicable to the product item as identified in this report. Telefication accepts no responsibility for any stated properties of product items in this test report, which are not supported by the tests as specified in section 7 "*Summary*".

All tests are performed by:

name : ing. J.C. le Clercq

Review of test report by:

name : ing. P.A. Suringa

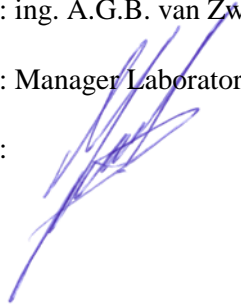
The above conclusions have been verified by the following signatory:

date : 25 February 2015

name : ing. A.G.B. van Zwieten

function : Manager Laboratory a.i.

signature :



Test results module

1 General information

1.1 Equipment information

Type of equipment	Remote Control using IEEE 802.15.4 (Zigbee)	
Modulation	O-QPSK	
Spreading type	DSSS	
Chip rate	2Mbit/s	
Data rate	38.4 Kbit/s	
Emission designator	2M50M1D	
Operating frequencies (channel set)	Channel	Freq (GHz)
	1	2.425
	2	2.450
	3	2.475
Rated RF antenna power density	20 mW/MHz (conducted)	
Type of antenna	2 PCB antennas, F type	

The 2014-RC003-02 Remote Control has three wired ports:
Power port, USB port and debug port.

None of these ports is for the end user. They are only for production purposes, if e.g. the software needs to be updated.

1.2 Tested channels

Operating frequencies as stated in clause 1.1 Equipment information.

2 Emission tests

2.1 Maximum conducted output power

Compliance standard : FCC part 15, subpart C, section 15.247 (b) (3)
Method of test : FCC KDB publication No. 558074 D01 v03r01
Ambient temperature : 23 °C
Relative humidity : 36 %

Test results :

Mode	Level (dBm)		
	CH 1	CH 2	CH 3
Continuously transmitting	13.50	13.44	13.41

Measurement uncertainty: + 1.6 /- 1.9 dB

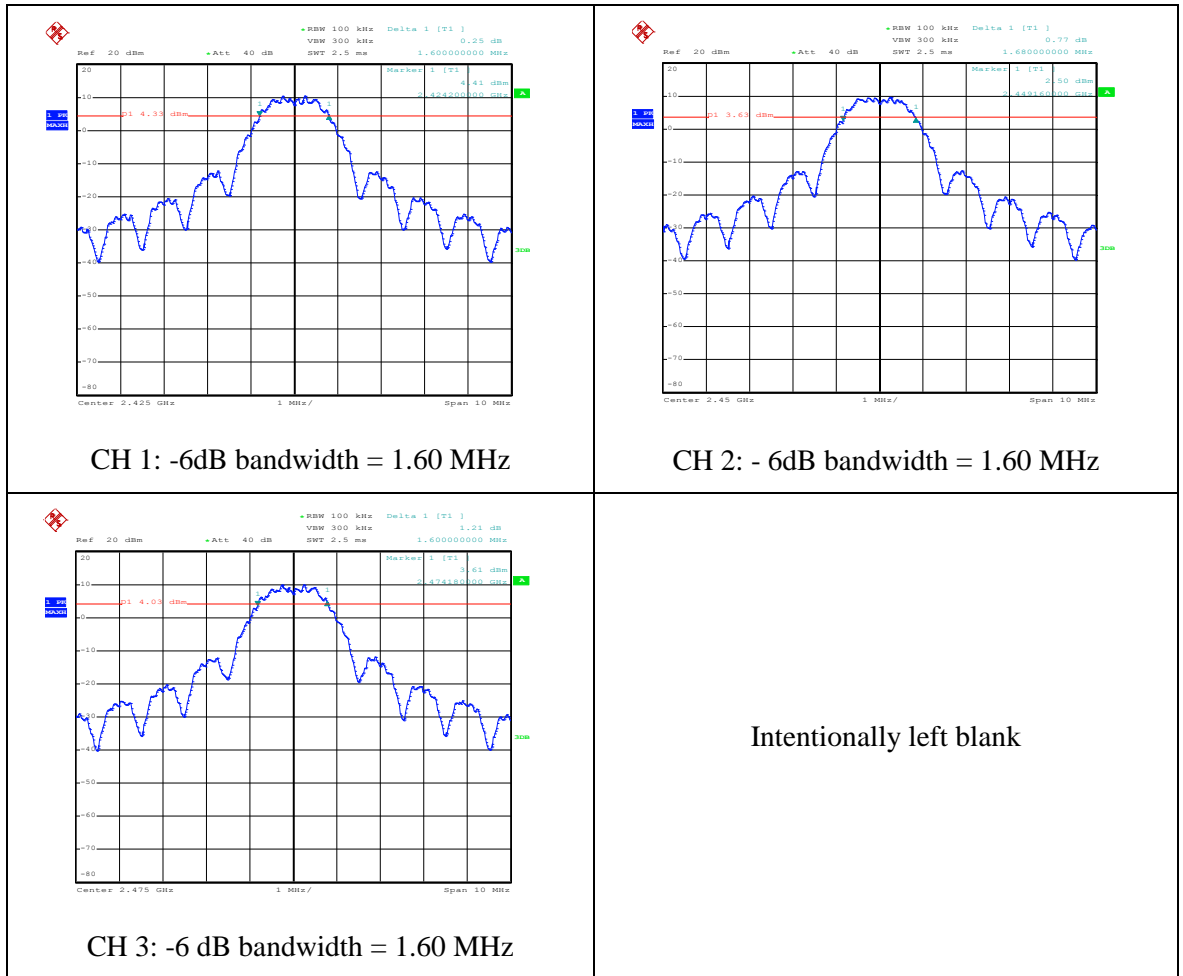
Limit:

Maximum conducted output power	≤ 30 dBm (antenna gain < 6 dBi)
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2.2 Minimum 6 dB bandwidth

Compliance standard : FCC part 15, subpart C, section 15.247 (a) (2)
 Method of test : FCC KDB publication No. 558074 D01 v03r01
 Ambient temperature : 23 °C
 Relative humidity : 36 %

Test results :



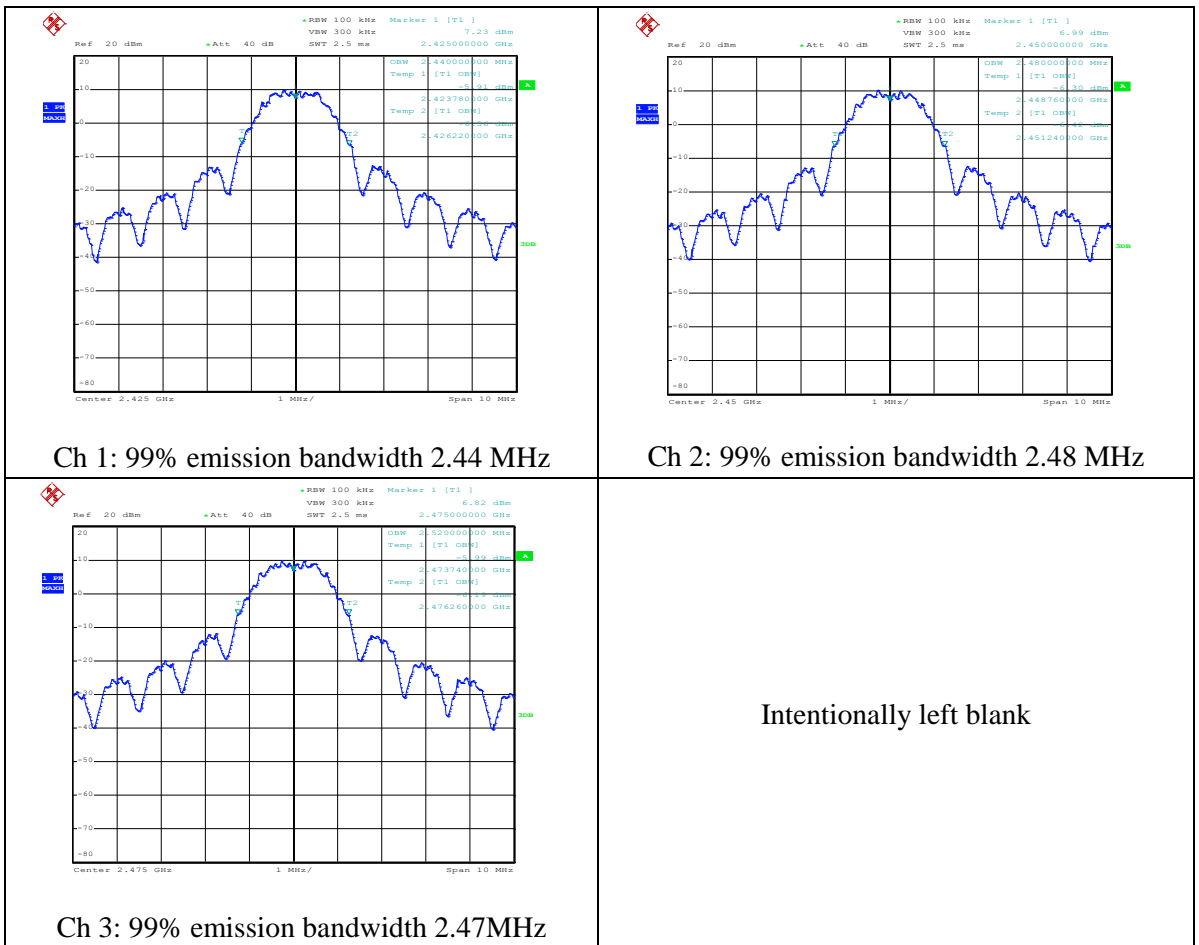
Measurement uncertainty: +/- 2 kHz

Limit:

Minimum 6 dB bandwidth	at least 500 kHz
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2.3 99% emission bandwidth

Compliance standard : IC RSS-Gen, section 4.6.1
 Method of test : IC RSS-Gen, section 4.6.1
 Ambient temperature : 23 °C
 Relative humidity : 36 %



Intentionally left blank

Measurement uncertainty: +/- 2 kHz

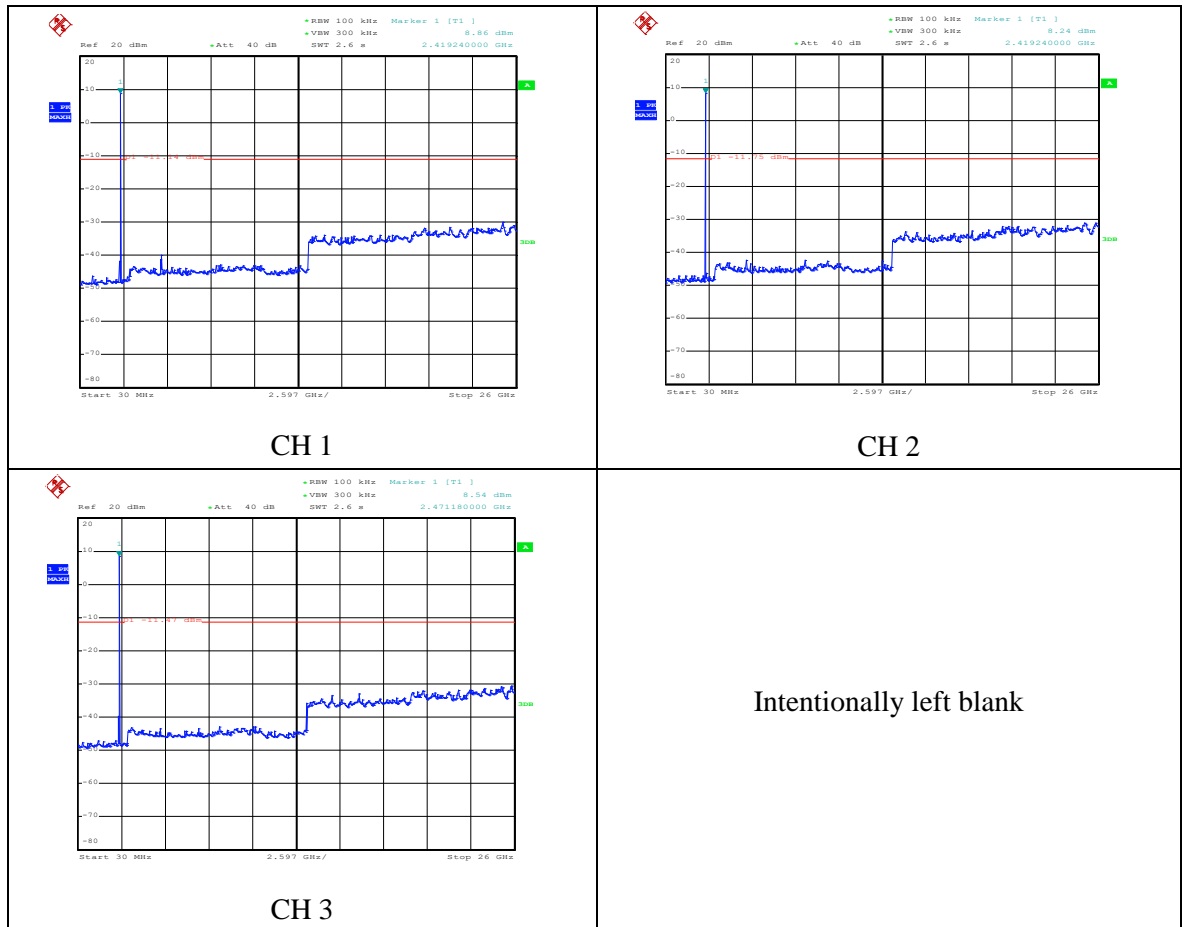
Limit:

99% emission bandwidth	Not applicable
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2.4 TX unwanted emissions attenuation (conducted, 0.03 - 26 GHz)

Compliance standard : FCC part 15, subpart C, section 15.247(d)
 Method of test : FCC KDB publication No. 558074 D01 v03r01
 Ambient temperature : 23 °C
 Relative humidity : 36 %

Test results :



Measurement uncertainty: < 2 GHz: + 1.7/- 1.9 dB;
 ≥ 2 GHz: +2.4/-2.7 dB

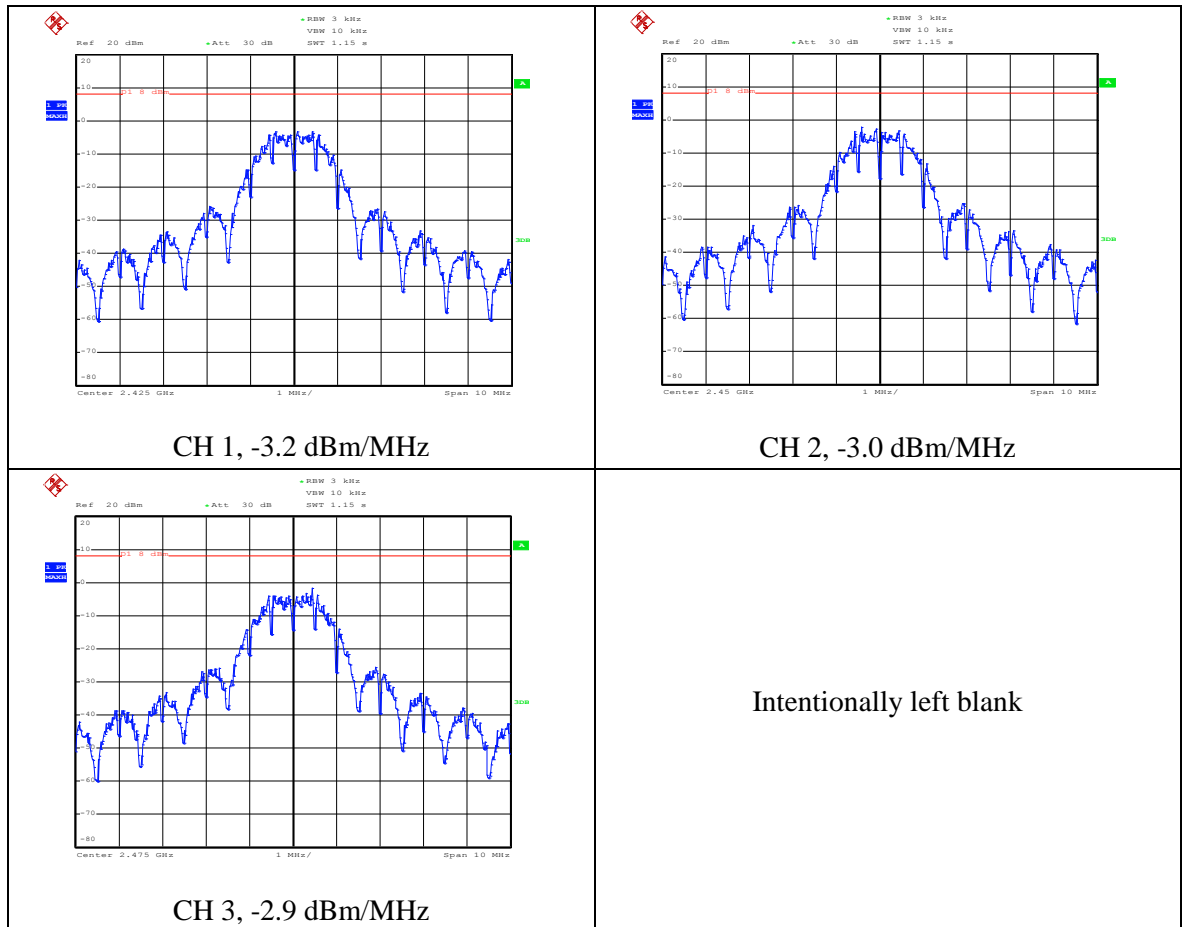
Limit:

In any 100 kHz bandwidth	At least 20 dB down from the highest emission level within the authorized band as measured with a 100 kHz bandwidth.
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2.5 Power spectral density conducted to the antenna

Compliance standard : FCC part 15, subpart C, section 15.247(e)
 Method of test : FCC KDB publication No. 558074 D01 v03r01
 Ambient temperature : 23 °C
 Relative humidity : 36 %

Test results :



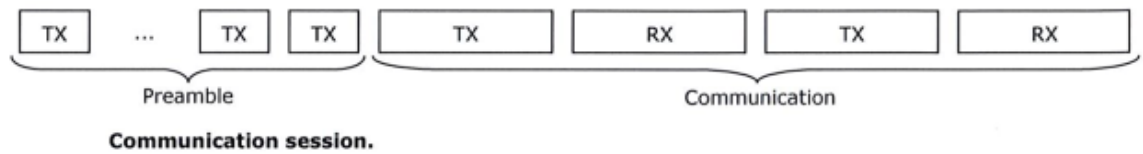
Measurement uncertainty: < 2 GHz: + 1.7/- 1.9 dB;
 ≥ 2 GHz: + 2.4/- 2.7 dB

Limit:

In any 3 kHz band	Not greater than 8 dBm during any time of continuous transmission
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2.6 Average factor

Compliance standard : --
 Method of test : FCC part 15, subpart C, section 15.35 (b) and (c)
 Ambient temperature : 23 °C
 Relative humidity : 36 %
 Test results :



Worst case controller duty cycle in 100 ms is when communicating with a low power (LPM) actuator where a preamble frame are sent each ms for 510 ms. Each preamble frame has a length of 11 bytes (88 bit), which gives a transmission time of; $88 \text{ bit}/250\text{kbps} = 352 \mu\text{s}$. In 1 ms this equals a duty cycle of $352 \mu\text{s}/1 \text{ ms} = 35.2 \%$

In RF power this gives the following difference in dB between peak and average:
 $20 \log_{10} 0.352 = -9.0 \text{ dB}$

2.7 TX unwanted emissions in the restricted bands

Compliance standard : FCC part 15, subpart C, section 15.247(d)
 Method of test : FCC KDB publication No. No. 558074 D01 v03r01
 Ambient temperature : 23 °C
 Relative humidity : 36 %

Test results :

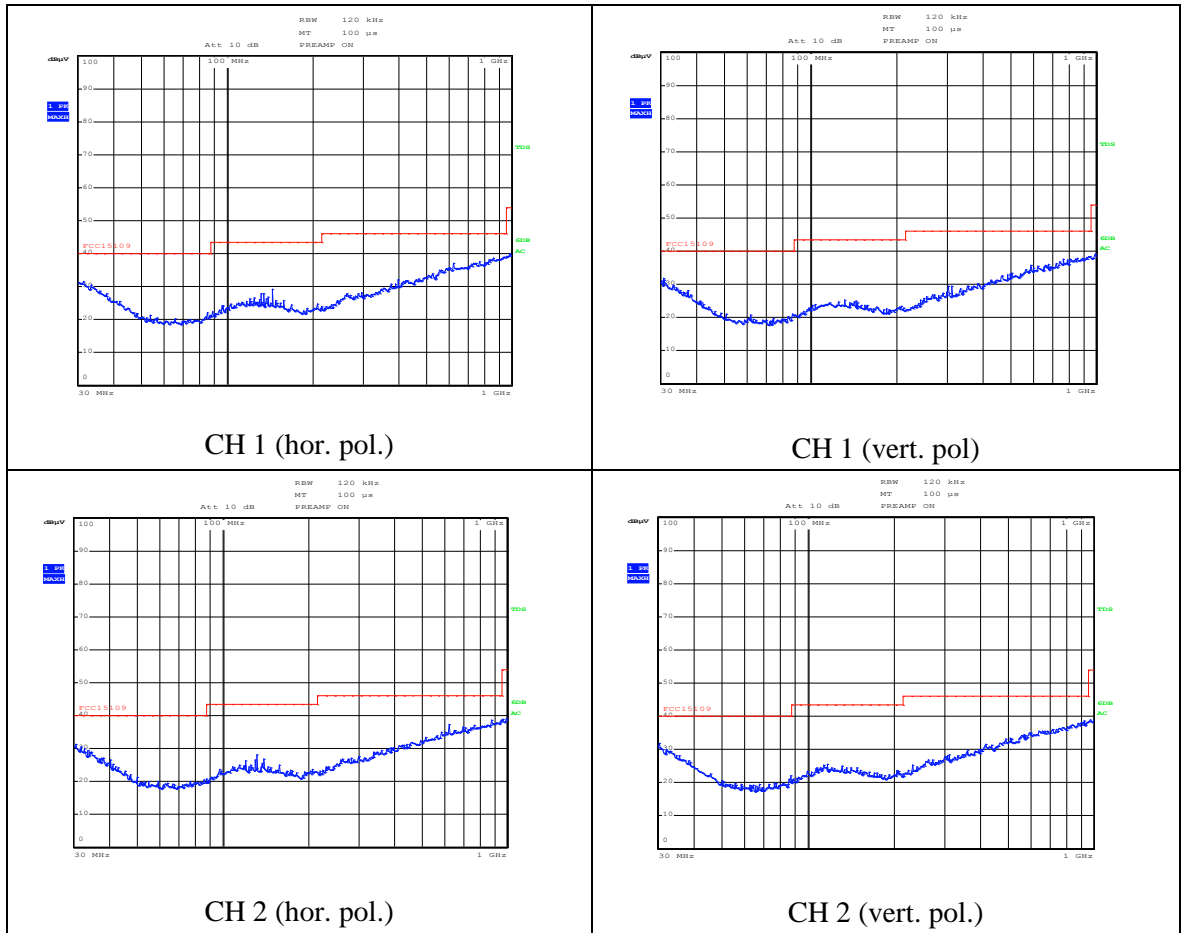
Frequency (MHz)	Test results peak (dBµV/m)		Average factor (dB)	Test results average (dBµV/m)		Resolution bandwidth (kHz)	Peak limit (dBµV/m)	Average limit (dBµV/m)
	@ 3m			@3m				
	V	H		V	H			
4850	61.2	59.8	-9.0	52.2	50.8	1000	74	54
4900	61.2	61.4	-9.0	52.2	52.4	1000	74	54
4950	60.7	60.4	-9.0	51.7	51.4	1000	74	54
7275	59.7	55.1	-9.0	50.7	46.1	1000	74	54
7350	62.7	53.5	-9.0	53.7	44.5	1000	74	54
7425	50.0	53.6	-9.0	41.0	44.6	1000	74	54
9600	53.3	47.5	-9.0	44.3	38.5	1000	74	54
9700	51.8	47.0	-9.0	42.8	38.0	1000	74	54
9800	45.4	46.9	-9.0	36.4	37.9	1000	74	54
12125	62.4	53.3	-9.0	53.4	44.3	1000	74	54
12250	62.3	56.3	-9.0	53.3	47.3	1000	74	54
12375	61.6	56.2	-9.0	52.6	47.2	1000	74	54

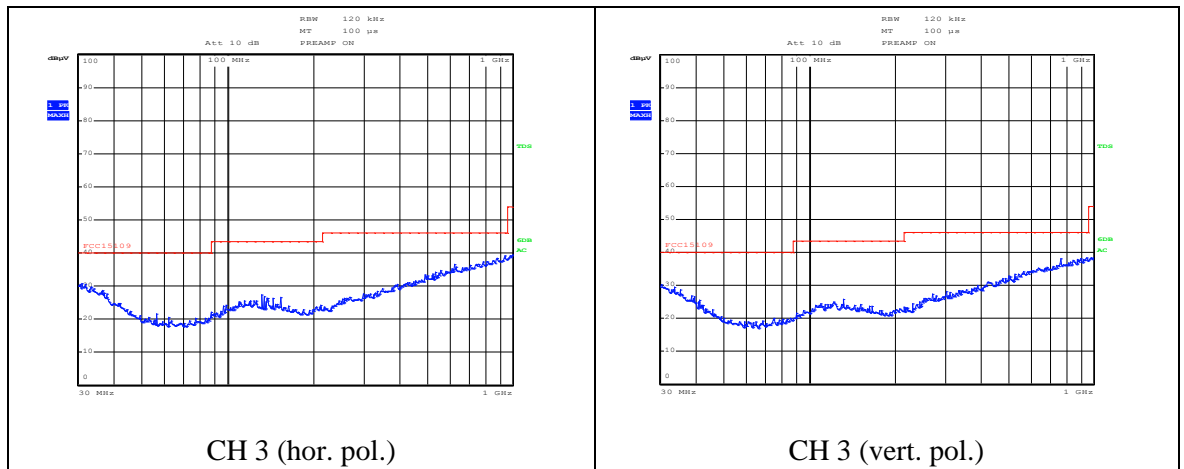
Measurement uncertainty: +4.5 / -6.1 dB

2.8 RX unwanted emissions (radiated, 0.03 - 1 GHz)

Compliance standard : FCC part 15, subpart B, section 15.109
 Method of test : ANSI C63.10-2009, section 6.5.4.2
 Ambient temperature : 23 °C
 Relative humidity : 36 %

Test results :





Measurement uncertainty:

Horizontal polarization	
30 – 200 MHz	4.5 dB
200 – 1000 MHz	3.6 dB
Vertical polarization	
30 – 200 MHz	5.4 dB
200 – 1000 MHz	4.6 dB

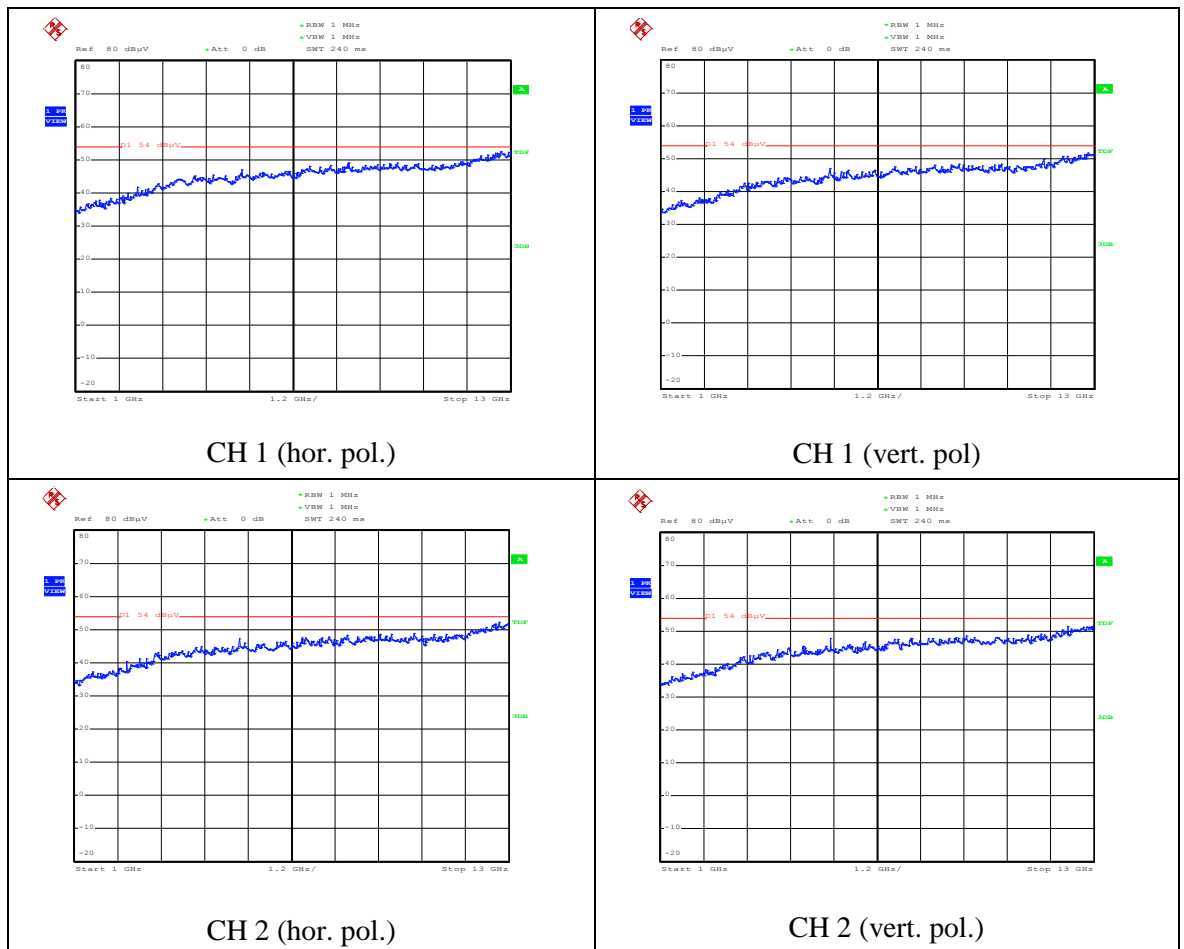
Limit:

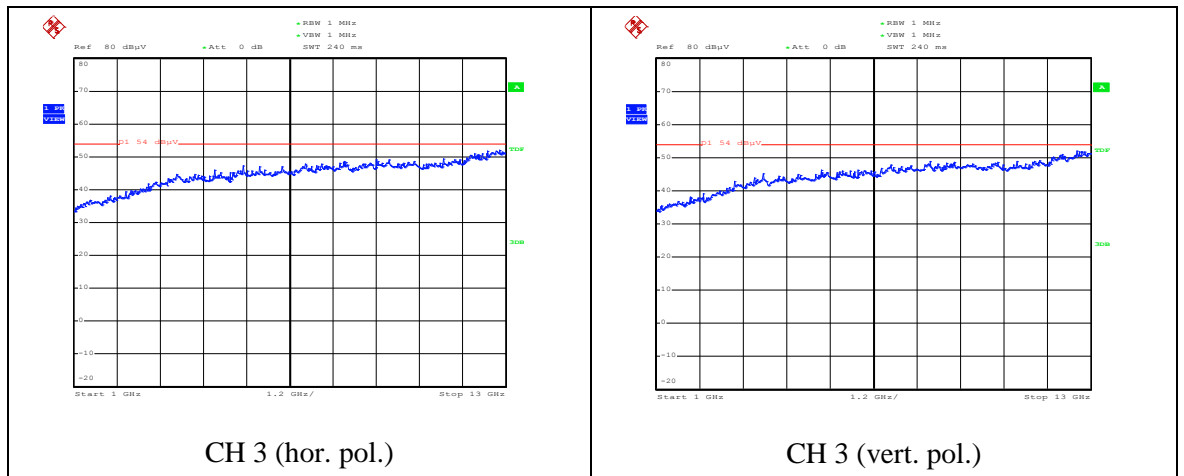
Field strength at 3 meter distance	30 – 88 MHz: ≤ 40 dBµV/m; 88 – 216 MHz: ≤ 43.5 dBµV/m; 216 – 960 MHz: ≤ 46 dBµV/m; Above 960 MHz: ≤ 54 dBµV/m
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2.9 RX unwanted emissions (radiated, 1 - 13 GHz)

Compliance standard : FCC part 15, subpart B, section 15.109
 Method of test : ANSI C63.10-2009: section 6.6
 Ambient temperature : 23 °C
 Relative humidity : 36 %

Test results :





Measurement uncertainty: +4.5 / -6.1 dB

Limit:

Field strength @ 3 meter	Above 1 GHz: ≤ 54 dBμV/m
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Used test equipment module

Description	ID	Manufacturer	Model	Used at par.
Spectrum Analyzer	TE 11125	Rohde & Schwarz	FSP 40	2.2, 2.3, 2.4, 2.5, 2.7, 2.8, 2.9
Power meter	TE 00489	Hewlett Packard	437B	2.1
Power sensor	TE 00485	Hewlett Packard	8481A	2.1
Pre amplifier	TE 11132	Miteq	AFS42-041001800-28-OP-42	2.9
Horn antenna	TE 00531	EMCO	3115	2.7, 2.9
Semi Anechoic Room	TE 00861	Comtest	--	2.7, 2.8, 2.9
EMI test receiver	TE 00481	Rohde & Schwarz	ESCI	2.8
Biconilog antenna	TE 00967	Chase	CBL6112A	2.8

Cross reference table

Transmitter	
IC RSS-210 Issue 8, Annex 8	FCC 47 CFR Ch. 1 part 15, subpart C (10-1-14 Edition)
A8.2 (a)	§ 15.247 (a) (2)
A8.4 (4)	§ 15.247 (b) (3)
A8.2 (b)	§ 15.247 (e)
A8.5	§ 15.247 (d)
IC RSS-Gen Issue 4	FCC 47 CFR Ch. 1 part 15, subpart C (10-1-14 Edition)
§ 4.6.1	--
Receiver	
IC RSS-Gen Issue 4	FCC 47 CFR Ch. 1 part 15, subpart B (10-1-14 Edition)
§ 7.2.3	§ 15.109